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HARNESS, DICKEY & PIERCE, P.L.C.
P.O. BOX 828
BLOOMFIELD HILLS, MI 48303

EXAMINER	
UHLENHAKE, JASON S	

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2853	

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Please find below and/or attached an Office communication concerning this application or proceeding.

H'A

Office Action Summary	Application No.	Applicant(s)	
	10/806,031	HIGUCHI ET AL.	
	Examiner	Art Unit	
	Jason Uhlenhake	2853	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☐ Responsive to communication(s) filed on _____.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) 1-27 is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) 1-27 is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

Claims 1, 2, 12, 23, 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano (U.S. Pat. 5,731,826) in view of Usui et al (U.S. Pub. 2002/0170353)

Hirano discloses:

- ***regarding claim 1,*** droplet ejection apparatus having a driving circuit (54) (Column19, Lines 3 – 7; 21 – 30) and a plurality of droplet ejection heads (Column 5, Lines 33 – 37)
- droplet ejection heads include a cavity (323d) filled with a liquid, a nozzle (323c) communicated with the cavity (Figures 6, 16A, 16B)
- ejection failure detecting and recovery processing determining means which detects a residual vibration of the diaphragm at least when the apparatus is powered on (Column 3, Lines 20 – 30; Column 7, Lines 32 – 40)
- recovery means for carrying out the recovery processing determined by the ejection failure detecting and recovery processing determining means (Column 10, Lines 60 – 67; Column 24, Lines 1 - 7)

- detects an ejection failure of the droplet ejection heads on the basis of a vibration pattern of the detected residual vibration of the diaphragm and determines recovery processing for eliminating ejection failure (Column 3, Lines 20 – 30; Column 7, Lines 32 – 40)

- ***regarding claim 2,*** ejection failure detecting and recovery processing determining means (Column 10, Lines 60 – 67; Column 24, Lines 1 - 7) detects the ejection failure of the droplet ejection heads on the basis of a vibration pattern (Column 3, Lines 20 – 30; Column 7, Lines 32 – 40)

Hirano does not disclose expressly:

- ***regarding claim 1,*** an actuator driven by the driving circuit and a diaphragm displaced by the actuator

- ***regarding claim 2,*** vibration pattern of the residual vibration of the diaphragm when the actuator is driven by the driving circuit to such an extent that a droplet is not ejected

- ***regarding claim 12,*** vibration pattern of the residual vibration of the diaphragm includes a cycle of the residual vibration

- ***regarding claim 23,*** the actuator includes a piezoelectric actuator having a piezoelectric element and using a piezoelectric effect of the piezoelectric element

- ***regarding claim 27,*** droplet ejection apparatus includes an ink jet printer

Usui et al discloses:

- ***regarding claim 1,*** an actuator (106) driven by the driving circuit and a diaphragm displaced by the actuator (Paragraph 0169), for the purpose of printing more stability and reliably.

- ***regarding claim 2,*** vibration pattern of the residual vibration of the diaphragm when the actuator is driven by the driving circuit (Paragraphs 0107, 0169) to such an extent that a droplet is not ejected (Paragraph 0027; liquid held inside opening cavity), for the purpose of reliably detecting a liquid consumption status.

- ***regarding claim 12,*** vibration pattern of the residual vibration of the diaphragm includes a cycle of the residual vibration (Paragraph 0284 – resonant frequency), for the purpose of printing more stability and reliably

- ***regarding claim 23,*** the actuator includes a piezoelectric actuator having a piezoelectric element and using a piezoelectric effect of the piezoelectric element (Paragraphs 0009, 0161), for the purpose of printing more stability and reliably.

- ***regarding claim 27,*** droplet ejection apparatus includes an ink jet printer (Paragraph 0003), for the purpose of performing the operation of the droplet ejection apparatus.

At the time the invention was made it would have been obvious to a person of ordinary skill in the art to incorporate the teaching of an actuator driven by the driving circuit and a diaphragm displaced by the actuator; vibration pattern of the residual vibration of the diaphragm when the actuator is driven by the driving circuit to such an extent that a droplet is not ejected; vibration pattern of the residual vibration of the diaphragm includes a cycle of the residual vibration; the actuator includes a

piezoelectric actuator having a piezoelectric element and using a piezoelectric effect of the piezoelectric element; droplet ejection apparatus includes an ink jet printer as taught by Usui et al into the device of Hirano. The motivation for doing so would have been to print more stability and reliably, perform the operation of the droplet ejection apparatus, and to reliably detect a liquid consumption status.

Claim 3 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano (U.S. Pat. 5,731,826) as modified by Usui et al (U.S. Pub. 2002/0170353), as applied to claim 1 above, and further in view of Ishinaga et al (U.S. Pub. 2002/0149657).

Hirano as modified by Usui et al discloses:

- ***regarding claim 3,*** vibration pattern of the residual vibration of the diaphragm (Hirano: Column 3, Lines 20 – 30; Column 7, Lines 32 – 40)

Hirano as modified by Usui et al does not discloses expressly the following:

- ***regarding claim 3,*** the ejection failure detecting and recovery processing determining means identifies a cause of the ejection failure of the droplet ejection heads

Ishinaga et al discloses:

- ***regarding claim 3,*** the ejection failure detecting and recovery processing determining means identifies a cause of the ejection failure of the droplet ejection heads (Paragraphs 25, 201 – 203), for the purpose of maintaining a quality print image.

At the time the invention was made it would have been obvious to a person of ordinary skill in the art to incorporate the teaching of ejection failure detecting and

recovery processing determining means identifies a cause of the ejection failure of the droplet ejection heads as taught by Ishinaga et al into the device of Hirano as modified by Ushi et al. The motivation for doing so would have been to maintaining a quality print image.

Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano (U.S. Pat. 5,731,826) as modified by Usui et al (U.S. Pub. 2002/0170353) and Ishinaga et al (U.S. Pub. 2002/0149657), as applied to claim 1 above, and further in view of Yamaguchi et al (U.S. Pat. 5,379,061).

Hirano as modified by Usui et al and Ishinaga et al discloses all the claimed limitations except for the following:

- ***regarding claim 4,*** the ejection failure detecting and recovery processing determines the recovery processing for eliminating the cause of the ejection failure of the droplet ejection heads according to the cause of the ejection failure in the case where the ejection failure of the droplet ejection heads is detected

Yamaguchi et al discloses:

- ***regarding claim 4,*** the ejection failure detecting and recovery processing determines the recovery processing for eliminating the cause of the ejection failure of the droplet ejection heads according to the cause of the ejection failure in the case where the ejection failure of the droplet ejection heads is detected (Abstract; Column 2, Lines 13 – 43), for the purpose of maintaining high printing quality.

At the time the invention was made it would have been obvious to a person of ordinary skill in the art to incorporate the teaching of the ejection failure detecting and recovery processing determines the recovery processing for eliminating the cause of the ejection failure of the droplet ejection heads according to the cause of the ejection failure in the case where the ejection failure of the droplet ejection heads is detected as taught by Yamaguchi et al into the device of Hirano as modified by Usui et al and Ishinaga et al. The motivation for doing so would have been to maintain high printing quality.

Claims 5, 6, 7 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano (U.S. Pat. 5,731,826) as modified by Usui et al (U.S. Pub. 2002/0170353), as applied to claim 1 above, and further in view of Yamaguchi et al (U.S. Pat. 5,379,061).

Hirano as modified by Usui et al discloses all the claimed limitations except for the following:

- ***regarding claim 5,*** recovery means includes: wiping means for carrying out a wiping process in which a nozzle surface of the droplet ejection heads where the nozzles are arranged is wiped with a wiper; means for carrying out a flushing process by which the droplets are preliminarily ejected through the nozzles of the droplet ejection heads by driving the actuator; pumping means for carrying out a pump-suction process with the use of a pump connected to a cap that covers the nozzle surface of the droplet ejection heads.

- ***regarding claim 6,*** select the pump-suction process as the recovery processing for eliminating the cause of the ejection failure in the case where it is judged that the cause of the ejection failure of the droplet ejection heads is intrusion of an air bubble into the cavity.

- ***regarding claim 7,*** select at least the wiping process as the recovery processing for eliminating the cause of the ejection failure in the case where it is judged that the cause of the ejection failure of the droplet ejection heads is adhesion of paper dust in the vicinity of an outlet of the nozzle

Yamaguchi et al discloses:

- ***regarding claim 5,*** recovery means includes: wiping means for carrying out a wiping process in which a nozzle surface of the droplet ejection heads where the nozzles are arranged is wiped with a wiper (Column 25, Lines 44 - 67; Column 26, Lines 1 – 10); flushing means for carrying out a flushing process by which the droplets are preliminarily ejected through the nozzles of the droplet ejection heads by driving the actuator (Column 5, Lines 19 – 67; Column 6, Lines 1-7); pumping means for carrying out a pump-suction process with the use of a pump connected to a cap that covers the nozzle surface of the droplet ejection heads (Column 5, Lines 19 – 67; Column 6, Lines 1 - 7), for the purpose of removing any kind of blockage or debris that would effect the quality of printing.

- ***regarding claim 6,*** select the pump-suction process as the recovery processing for eliminating the cause of the ejection failure in the case where it is judged that the cause of the ejection failure of the droplet ejection heads is intrusion of an air

bubble into the cavity (Column 6, Lines 26 – 33), for the purpose of removing air bubbles in the apparatus to maintain high print quality.

- ***regarding claim 7,*** select at least the wiping process as the recovery processing for eliminating the cause of the ejection failure in the case where it is judged that the cause of the ejection failure of the droplet ejection heads is adhesion of paper dust in the vicinity of an outlet of the nozzle (Column 25, Lines 44 - 67; Column 26, Lines 1 – 10), for the purpose of removing debris to maintain high print quality.

At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to incorporate the teaching of recovery means includes: wiping means for carrying out a wiping process in which a nozzle surface of the droplet ejection heads where the nozzles are arranged is wiped with a wiper; means for carrying out a flushing process by which the droplets are preliminarily ejected through the nozzles of the droplet ejection heads by driving the actuator; pumping means for carrying out a pump-suction process with the use of a pump connected to a cap that covers the nozzle surface of the droplet ejection heads; select the pump-suction process as the recovery processing for eliminating the cause of the ejection failure in the case where it is judged that the cause of the ejection failure of the droplet ejection heads is intrusion of an air bubble into the cavity; select at least the wiping process as the recovery processing for eliminating the cause of the ejection failure in the case where it is judged that the cause of the ejection failure of the droplet ejection heads is adhesion of paper dust in the vicinity of an outlet of the nozzle as taught by Yamaguchi et al into the device

of Hirano as modified by Usui et al. The motivation for doing so would have been to remove any kind of blockage or debris that would affect the quality of printing.

Claims 8, 9 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano (U.S. Pat. 5,731,826) as modified by Usui et al (U.S. Pub. 2002/0170353), and Yamaguchi et al (U.S. Pat. 5,379,061), as applied to claim 1 above, and further in view of Fujii (U.S. Pat. 6,299,277)

Hirano as modified by Usui et al and Yamaguchi et al discloses all of the claimed limitations except for the following:

- ***regarding claim 8,*** selects the flushing process or the pump-suction prcess as the recovery processing for eliminating the cause of the ejection failure in the case where it is judged that the cause of the ejection failure of the droplet ejection heads is thickening of the liquid In the vicinity of the nozzle due to drying
- ***regarding claim 9,*** selects the flushing process as the recovery processing for eliminating the cause of the ejection failure in the case where it is judged that the cause of the ejection failure of the droplet ejection heads is thickening of the liquid In the vicinity of the nozzle due to drying

Fujii discloses the following:

- ***regarding claim 8,*** selects the flushing process or the pump-suction prcess as the recovery processing for eliminating the cause of the ejection failure in the case where it is judged that the cause of the ejection failure of the droplet ejection heads is thickening of the liquid In the vicinity of the nozzle due to drying (Column 2,

Lines 5 – 27; Column 8, Lines 20 – 50), for the purpose of removing blockage from the nozzle to maintain high print quality.

- ***regarding claim 9,*** selects the flushing process as the recovery processing for eliminating the cause of the ejection failure in the case where it is judged that the cause of the ejection failure of the droplet ejection heads is thickening of the liquid In the vicinity of the nozzle due to drying (Column 2, Lines 5 – 27; Column 8, Lines 20 – 50), for the purpose of removing blockage from the nozzle to maintain high print quality.

At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to incorporate the teaching of selects the flushing process or the pump-suction prcess as the recovery processing for eliminating the cause of the ejection failure in the case where it is judged that the cause of the ejection failure of the droplet ejection heads is thickening of the liquid In the vicinity of the nozzle due to drying; selects the flushing process as the recovery processing for eliminating the cause of the ejection failure in the case where it is judged that the cause of the ejection failure of the droplet ejection heads is thickening of the liquid In the vicinity of the nozzle due to drying as taught by Fugii into the device of Hirano as modified by Usui et al and Yamaguchi et al. The motivation for doing so would have been to remove blockage from the nozzle to maintain high print quality.

Claims 10, 11 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano (U.S. Pat. 5,731,826) as modified by Usui et al (U.S. Pub. 2002/0170353), and

Yamaguchi et al (U.S. Pat. 5,379,061) and Fujii (U.S. Pat. 6,299,277), as applied to claim 1 above, and further in view of Hayakawa et al (U.S. Pub. 2002/0130918)

Hirano as modified by Usui et al and Yamaguchi et al and Fujii discloses all of the claimed limitations except for the following:

- ***regarding claim 10,*** wherein the ejection failure detecting and recovery processing determining means selects the pump-suction process as the recovery processing for eliminating the cause of the ejection failure in the case where the ejection failure is not eliminated even by carrying out the flushing process by the flushing means predetermined times

- ***regarding claim 11,*** informing means for informing the fact that the ejection failure has not been eliminated in the case where the ejection failure is not eliminated even by carrying out the pump-suction process by the pumping means predetermined times

Hayakawa et al discloses:

- ***regarding claim 10,*** wherein the ejection failure detecting and recovery processing determining means selects the pump-suction process as the recovery processing for eliminating the cause of the ejection failure in the case where the ejection failure is not eliminated even by carrying out the flushing process by the flushing means predetermined times (Paragraph 0009)

- ***regarding claim 11,*** informing means for informing the fact that the ejection failure has not been eliminated (Paragraphs 0055 – 0056) in the case where the ejection failure is not eliminated even by carrying out the pump-suction process by

the pumping means predetermined times (predetermined clogging checking pattern) (Paragraph 0058)

Claims 13 - 21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano (U.S. Pat. 5,731,826) as modified by Usui et al (U.S. Pub. 2002/0170353), as applied to claim 1 above, and further in view of Sakagami et al (U.S. Pub. 2005/0122360)

The applied reference has a common applicant with the instant application. Based upon the earlier effective U.S. filing date of the reference, it constitutes prior art only under 35 U.S.C. 102(e). This rejection under 35 U.S.C. 103(a) might be overcome by: (1) a showing under 37 CFR 1.132 that any invention disclosed but not claimed in the reference was derived from the inventor of this application and is thus not an invention "by another"; (2) a showing of a date of invention for the claimed subject matter of the application which corresponds to subject matter disclosed but not claimed in the reference, prior to the effective U.S. filing date of the reference under 37 CFR 1.131; or (3) an oath or declaration under 37 CFR 1.130 stating that the application and reference are currently owned by the same party and that the inventor named in the application is the prior inventor under 35 U.S.C. 104, together with a terminal disclaimer in accordance with 37 CFR 1.321(c). This rejection might also be overcome by showing that the reference is disqualified under 35 U.S.C. 103(c) as prior art in a rejection under 35 U.S.C. 103(a). See MPEP § 706.02(l)(1) and § 706.02(l)(2).

Hirano as modified by Usui et al discloses all the claimed limitations except for the following:

- ***regarding claim 13,*** the ejection failure detecting and recovery processing determining means judges that: an air bubble has intruded into the cavity in the case where the cycle of the residual vibration of the diaphragm is shorter than a predetermined range of cycle; the liquid in the vicinity of the nozzle has thickened due to drying in the case where the cycle of the residual vibration of the diaphragm is longer than a predetermined threshold; and paper dust is adhering in the vicinity of the outlet of the nozzle in the case where the cycle of the residual vibration of the diaphragm is longer than the predetermined range of cycle and shorter than the predetermined threshold.

- ***regarding claim 14,*** wherein the ejection failure detecting and recovery processing determining means includes an oscillation circuit and the oscillation circuit oscillates in response to an electric capacitance component that varies with the residual vibration of the diaphragm.

- ***regarding claim 15,*** the ejection failure detecting and recovery processing determining means includes an oscillation circuit and the oscillation circuit oscillates in response to an electric capacitance component of the actuator that varies with the residual vibration of the diaphragm.

- ***regarding claim 16,*** the ejection failure detecting and recovery processing determining means includes a resistor element connected to the actuator, and the oscillation circuit forms a CR oscillation circuit based on the electric

capacitance component of the actuator and a resistance component of the resistor element.

- ***regarding claim 17,*** the ejection failure detecting and recovery processing determining means includes an F/V converting circuit that generates a voltage waveform in response to the residual vibration of the diaphragm from a predetermined group of signals generated based on changes in an oscillation frequency of an output signal from the oscillation circuit.

- ***regarding claim 18,*** the ejection failure detecting and recovery processing determining means includes a waveform shaping circuit that shapes the voltage waveform in response to the residual vibration of the diaphragm generated by the F/V converting circuit into a predetermined waveform.

- ***regarding claim 19,*** the waveform shaping circuit includes: DC component eliminating means for eliminating a direct current component from the voltage waveform of the residual vibration of the diaphragm generated by the F/V converting circuit; and a comparator that compares the voltage waveform from which the direct current component thereof has been eliminated by the DC component eliminating means with a predetermined voltage value; and wherein the comparator generates and outputs a rectangular wave based on this voltage comparison.

- ***regarding claim 20,*** the ejection failure detecting and recovery processing determining means includes measuring means for measuring the cycle of the residual vibration of the diaphragm based on the rectangular wave generated by the waveform shaping circuit.

- ***regarding claim 21,*** the measuring means has a counter, and measures either a time between rising edges of the rectangular wave or a time between a rising edge and falling edge of the rectangular wave by counting pulses of a reference signal with the counter.

Sakagami et al discloses:

- ***regarding claim 13,*** the ejection failure detecting and recovery processing determining means judges that: an air bubble has intruded into the cavity in the case where the cycle of the residual vibration of the diaphragm is shorter than a predetermined range of cycle; the liquid in the vicinity of the nozzle has thickened due to drying in the case where the cycle of the residual vibration of the diaphragm is longer than a predetermined threshold; and paper dust is adhering in the vicinity of the outlet of the nozzle in the case where the cycle of the residual vibration of the diaphragm is longer than the predetermined range of cycle and shorter than the predetermined threshold (Paragraph 0023), for the purpose of detecting ejection failure of the apparatus.

- ***regarding claim 14,*** wherein the ejection failure detecting and recovery processing determining means includes an oscillation circuit and the oscillation circuit oscillates in response to an electric capacitance component that varies with the residual vibration of the diaphragm (Paragraph 0024) , for the purpose of detecting ejection failure of the apparatus.

- ***regarding claim 15,*** the ejection failure detecting and recovery processing determining means includes an oscillation circuit and the oscillation circuit

oscillates in response to an electric capacitance component of the actuator that varies with the residual vibration of the diaphragm (Paragraph 0024) , for the purpose of detecting ejection failure of the apparatus.

- ***regarding claim 16,*** the ejection failure detecting and recovery processing determining means includes a resistor element connected to the actuator, and the oscillation circuit forms a CR oscillation circuit based on the electric capacitance component of the actuator and a resistance component of the resistor element (Paragraph 0024) , for the purpose of detecting ejection failure of the apparatus.

- ***regarding claim 17,*** the ejection failure detecting and recovery processing determining means includes an F/V converting circuit that generates a voltage waveform in response to the residual vibration of the diaphragm from a predetermined group of signals generated based on changes in an oscillation frequency of an output signal from the oscillation circuit (Paragraph 0026) , for the purpose of detecting ejection failure of the apparatus.

- ***regarding claim 18,*** the ejection failure detecting and recovery processing determining means includes a waveform shaping circuit that shapes the voltage waveform in response to the residual vibration of the diaphragm generated by the F/V converting circuit into a predetermined waveform(Paragraph 0026) , for the purpose of detecting ejection failure of the apparatus.

- ***regarding claim 19,*** the waveform shaping circuit includes: DC component eliminating means for eliminating a direct current component from the

voltage waveform of the residual vibration of the diaphragm generated by the F/V converting circuit; and a comparator that compares the voltage waveform from which the direct current component thereof has been eliminated by the DC component eliminating means with a predetermined voltage value; and wherein the comparator generates and outputs a rectangular wave based on this voltage comparison (Paragraph 0027) , for the purpose of detecting ejection failure of the apparatus.

- ***regarding claim 20,*** the ejection failure detecting and recovery processing determining means includes measuring means for measuring the cycle of the residual vibration of the diaphragm based on the rectangular wave generated by the waveform shaping circuit (Paragraph 0027) , for the purpose of detecting ejection failure of the apparatus.

- ***regarding claim 21,*** the measuring means has a counter, and measures either a time between rising edges of the rectangular wave or a time between a rising edge and falling edge of the rectangular wave by counting pulses of a reference signal with the counter (Paragraph 0027) , for the purpose of detecting ejection failure of the apparatus.

At the time the invention was made it would have been obvious to a person of ordinary skill in the art to incorporate the teaching of regarding claim 13, the ejection failure detecting and recovery processing determining means judges that: an air bubble has intruded into the cavity in the case where the cycle of the residual vibration of the diaphragm is shorter than a predetermined range of cycle; the liquid in the vicinity of the nozzle has thickened due to drying in the case where the cycle of the residual

vibration of the diaphragm is longer than a predetermined threshold; and paper dust is adhering in the vicinity of the outlet of the nozzle in the case where the cycle of the residual vibration of the diaphragm is longer than the predetermined range of cycle and shorter than the predetermined threshold; regarding claim 14, wherein the ejection failure detecting and recovery processing determining means includes an oscillation circuit and the oscillation circuit oscillates in response to an electric capacitance component that varies with the residual vibration of the diaphragm; regarding claim 15, the ejection failure detecting and recovery processing determining means includes an oscillation circuit and the oscillation circuit oscillates in response to an electric capacitance component of the actuator that varies with the residual vibration of the diaphragm; regarding claim 16, the ejection failure detecting and recovery processing determining means includes a resistor element connected to the actuator, and the oscillation circuit forms a CR oscillation circuit based on the electric capacitance component of the actuator and a resistance component of the resistor element; regarding claim 17, the ejection failure detecting and recovery processing determining means includes an F/V converting circuit that generates a voltage waveform in response to the residual vibration of the diaphragm from a predetermined group of signals generated based on changes in an oscillation frequency of an output signal from the oscillation circuit; regarding claim 18, the ejection failure detecting and recovery processing determining means includes a waveform shaping circuit that shapes the voltage waveform in response to the residual vibration of the diaphragm generated by the F/V converting circuit into a predetermined waveform; regarding claim

19, the waveform shaping circuit includes: DC component eliminating means for eliminating a direct current component from the voltage waveform of the residual vibration of the diaphragm generated by the F/V converting circuit; and a comparator that compares the voltage waveform from which the direct current component thereof has been eliminated by the DC component eliminating means with a predetermined voltage value; and wherein the comparator generates and outputs a rectangular wave based on this voltage comparison; regarding claim 20, the ejection failure detecting and recovery processing determining means includes measuring means for measuring the cycle of the residual vibration of the diaphragm based on the rectangular wave generated by the waveform shaping circuit; regarding claim 21, the measuring means has a counter, and measures either a time between rising edges of the rectangular wave or a time between a rising edge and falling edge of the rectangular wave by counting pulses of a reference signal with the counter as taught by Sakagami et al into the device of Hirano as modified by Usui et al. The motivation for doing so would have been to detect ejection failure.

Claim 22 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano (U.S. Pat. 5,731,826) as modified by Usui et al (U.S. Pub. 2002/0170353), as applied to claim 1 above, and further in view of Nojima et al (U.S. Pat. 6,168,263)

Hirano as modified by Usui et al discloses all the claimed limitations except for the following:

- ***regarding claim 22,*** the actuator includes an electrostatic actuator

Nojima et al discloses:

- ***regarding claim 22,*** the actuator includes an electrostatic actuator (111) (Column 1, Lines 15 - 20), for the purpose of generating pressure to eject ink droplets.

At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to incorporate the teaching of the actuator includes an electrostatic actuator as taught by Sakai et al into the device of Hirano as modified by Usui et al. The motivation for doing so would have been to generate pressure to eject ink droplets

Claim 24 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano (U.S. Pat. 5,731,826) as modified by Usui et al (U.S. Pub. 2002/0170353), as applied to claim 1 above, and further in view of Izumida et al (U.S. Pat. 5,371,528)

Hirano as modified by Usui et al discloses all the claimed limitations except for the following:

- ***regarding claim 24,*** actuator includes a film boiling actuator provided with a heating element that generates heat when and electric current flows therethrough

Izumida et al discloses:

- ***regarding claim 24,*** actuator includes a film boiling actuator provided with a heating element that generates heat when and electric current flows therethrough (Column 9, Lines 65 – 67; Column 10, Lines 1 – 15), for the purpose of efficiently ejecting ink droplets.

At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to incorporate the teaching of actuator includes a film boiling actuator provided with a heating element that generates heat when and electric current flows therethrough as taught by Izumida et al into the device of Hirano as modified by Usui et al. The motivation for doing so would have been to efficiently eject ink droplets.

Claim 25 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano (U.S. Pat. 5,731,826) as modified by Usui et al (U.S. Pub. 2002/0170353) and of Izumida et al (U.S. Pat. 5,371,528), as applied to claim 1 above, and further in view of Hotomi et al (U.S. Pat. 6,145,966)

Hirano as modified by Usui et al and Izumida et al discloses all the claimed limitations except for the following:

- ***regarding claim 25,*** the diaphragm deforms elastically so as to follow a change in the internal pressure of the cavity

Hotomi et al discloses:

- ***regarding claim 25,*** the diaphragm deforms elastically so as to follow a change in the internal pressure of the cavity (Column 1, Lines 38 – 50), for the purpose of having a stable ejection characteristic of the droplet ejection apparatus.

At the time the invention was made, it would have been obvious to a person of ordinary skill in the art to incorporate the teaching of the diaphragm deforms elastically so as to follow a change in the internal pressure of the cavity as taught by Hotomi et al into the device of Hirano as modified by Usui et al and Izumida et al. The motivation for

doing so would have been to have a stable ejection characteristic of the droplet ejection apparatus.

Claim 26 is rejected under 35 U.S.C. 103(a) as being unpatentable over Hirano (U.S. Pat. 5,731,826) as modified by Usui et al (U.S. Pub. 2002/0170353), as applied to claim 1 above, and further in view of Kono et al (U.S. Pat. 6,322,190)

Hirano as modified by Usui et al discloses all the claimed limitations except for the following:

- ***regarding claim 26,*** storage means for storing a cause of the ejection failure of the droplets detected by the ejection failure detecting and recovery processing determining means in association with the droplet ejection head for which the detection was carried out

Kono et al discloses:

- ***regarding claim 26,*** storage means for storing a cause of the ejection failure of the droplets detected by the ejection failure detecting and recovery processing determining means in association with the droplet ejection head for which the detection was carried out (Column 2, Lines 24 – 31; Column 4, Lines 49 – 52; Column 5, Lines 5 – 11), for the purpose of detecting ejection failure.

At the time the invention was made it would have been obvious to a person of ordinary skill in the art to incorporate the teaching of storage means for storing a cause of the ejection failure of the droplets detected by the ejection failure detecting and recovery processing determining means in association with the droplet ejection head for

which the detection was carried out as taught by Kono et al into the device of Hirano as modified by Usui et al. The motivation for doing so would have been to detect ejection failure.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jason Uhlenhake whose telephone number is (571) 272-5916. The examiner can normally be reached on Monday - Friday 8-5.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Stephen Meier can be reached on (571) 272-2149. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

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JSU
February 13, 2006

K. FEGGINS
PRIMARY EXAMINER